Marmaray Project Sirkeci Rescue Excavations in the Case of Stratification as an Urban Archaeology Example and Its Effects on City Planning[1] [2]

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Abstract
The Marmaray Project was prepared to connect Asian and European parts of the Bosphorus as the biggest transportation project in Istanbul whereby it emerged a great opportunity to connect archaeological dots of the city's history and even surprised with a lot of new discoveries. Rescue excavations of the three major sites in Marmaray, were held under the authority of Istanbul Archaeological Museums (IAM) in 2004-2012, became the most important example of urban archaeology in the history of Turkey. This paper is focused on Sirkeci Station of Marmaray within the Historic Peninsula where archaeological stratification has demonstrated the architectural inventory from Early Turkish Republican, Ottoman, Byzantine to Roman Period (also some published archaeological pieces dated to Hellenistic Period). Rescue excavations implement with some problems not only about time but also documentation process. For instance, classical documentation process could hold all information about archaeological inventory with report and CAD folder and consequently, this crucial inventory cannot be a part of not only the scientific investigation but also modern planning process. This paper offers a solution with a GIS project as a contemporary digitalization and documentation method. With the contribution of the GIS, archaeological potential can present its periodical changes by examining the ancient topography, architectural remnants, their building techniques, materials, and urban relationships. For this reason, documentation of Sirkeci Rescue Excavations was transferred to the GIS database and its opportunity of the multidisciplinary perspective was discussed.

Keywords: Urban archaeology, rescue excavations, Marmaray Project, multi-layered, Istanbul, GIS, stratification

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Introduction

This paper focuses on why the Geographical Information Systems (GIS) is needed for a multidisciplinary approach, and how an important role it has on both archaeological research and urban planning process in a case of Marmaray Project Sirkeci Rescue Excavations in Istanbul.

Our method is to represent a model with GIS Database for architectural archive process of this rescue excavations. The digital archive used for recording archaeological interventions' data is a part of a larger archive which, alongside archaeological data, also included data from historical maps, the current situation of the physical environment, plan decisions for the future and so on. Moreover, the GIS application on the archive of archaeological determination has so far been facilitating, mainly due to multidisciplinary research and city planning process.
Marmaray Transportation Project which was planned by not taking the account of the archaeological potential reveals the most valuable archaeological deposits of the city on the contrary. This GIS database of Sirkeci Rescue Excavations is one of the beneficial results of Marmaray.

1. Marmaray Transportation Project

Istanbul is a modern metropolis with a very rich history and important location which is situated on two parts called European and Asian side by the Bosphorus on the north coast of Turkey. It houses more than 15 million population which causes a lot of urban problems. The worst one is a traffic congestion all around the city.
One of the most important projects to propose a solution for this traffic problem was Marmaray[3] Transportation Project which is commuter rail mass transit system, connecting the old rail lines, by upgrading them, to new ones with a tube tunnel under Bosphorus (Belkaya, Ozmen, Karamut, 2008: 26) (Fig.1).

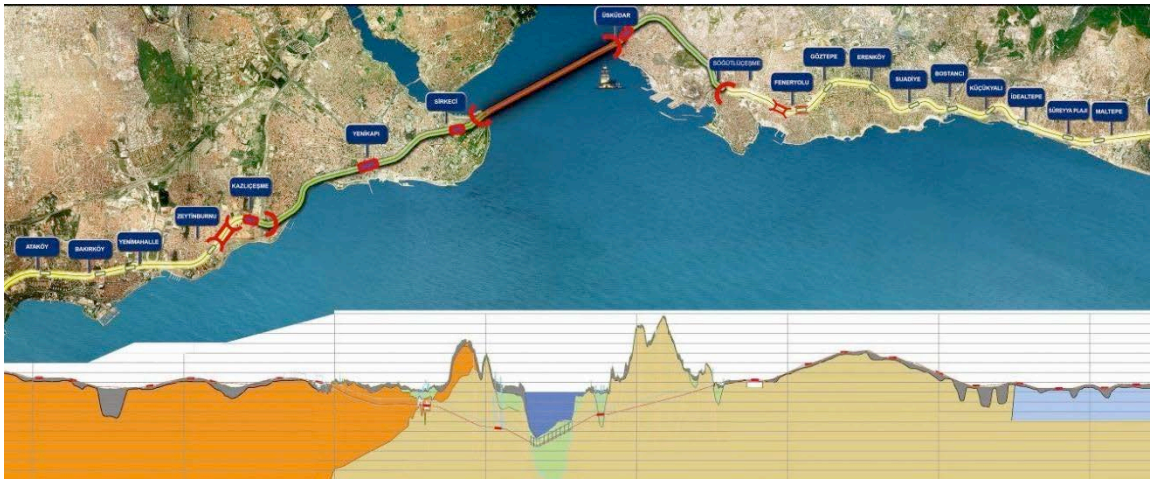

Fig. 1: The Marmaray Project Route Plan and Section (Altun&Baltaş, 2014: 30-31)

The project started in 2004 by the authority of the Ministry of Transportation (Ozmen, 2007: 26). After a while project started, archaeological pieces were found which started the rescue excavations.

[3] Marmaray is combined word with Marmara the name of the sea, and ray is Turkish word for rail.

2. Rescue Excavations

According to legislation in Turkey, archaeological excavations can be made by the permission of the TC. Ministry of Culture and Tourism. Archaeological museums and universities carry out excavation work under the authority of Ministry. In addition to scientific excavations, due to the demands of private property and public needs, also rescue excavations are conducted in both rural and urban conditions. Marmaray Transportation Project was an urgent need of the city and its rescue excavations conducted by IAM.

Marmaray Rescue Excavations was the biggest urban excavation project in Turkey not only by the means of square meter but also about the content. Three stations, Yenikapı and Sirkeci in the Historical Peninsula and Usküdar and Ayrılıkçeşme on the Asian side had these excavations (Fig.2).

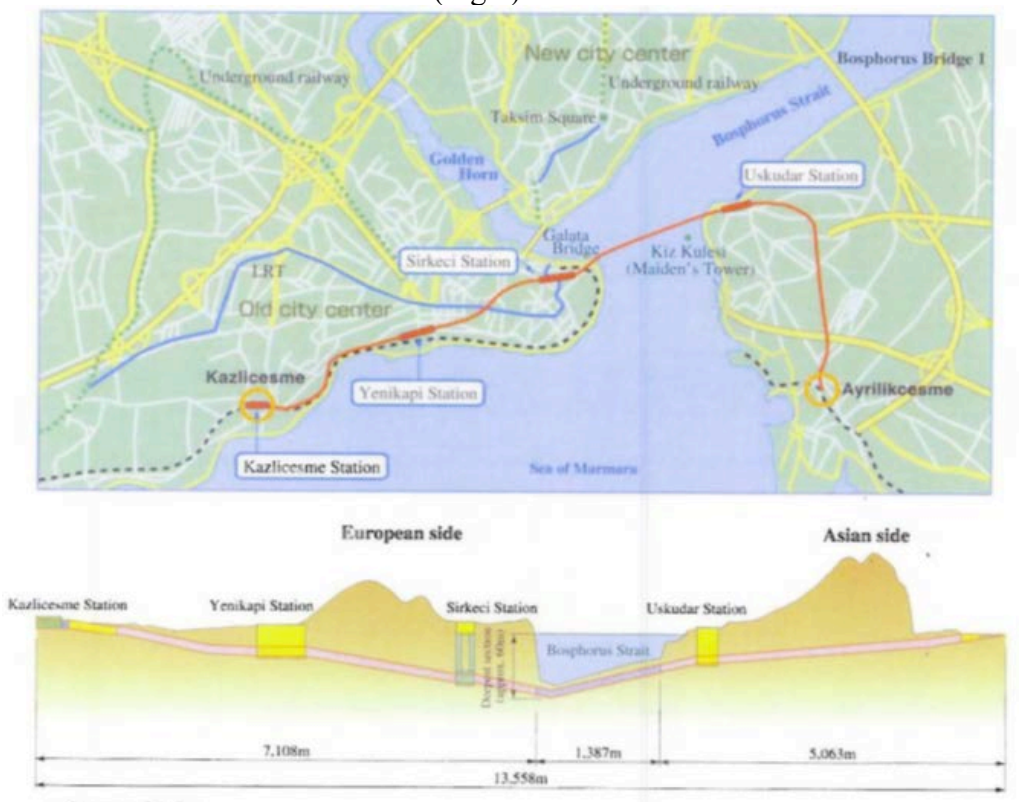

Fig. 2: The Marmaray Rail Tube Tunnel Plan and Section (Heidenhain, 2010: 1)

The excavations started in 2004 and they took eight years to finish. After archaeological site works were completed in 2012, one more year was needed for the final documentation. When everything was finished, all the material and archive was handed to IAM. Meanwhile, Marmaray was opened in 2013. It has been used every day by a large number of people since then.

As the beginning of Marmaray Project, no one would think that its rescue excavations would change and enlighten the history of Historical Peninsula and Istanbul, a cultural heritage site of UNESCO, with a huge amount of archaeological and architectural evidence dating to different periods. Existing fabric of the city has been peeled for new infrastructures such as subways which helped archaeologists to understand the historical stratification in a new sense (Crow, 2007: 252).

Rescue excavations have different properties than rural archaeology in terms of time, working conditions and administrative issues. Example of Marmaray set up a lot of priorities for urban excavations. The site work was handled in every weather condition because it continued for whole year. The shifts were regular from 8 am to 5 pm but for some periods, there were three shifts for 24 hours. The construction project was also going on which created intersected process by sharing the neighbourhood of the archaeological site. Also, structures needed some consolidation for safety reasons, the archaeological area was bounded in these terms.

Archaeology has a multidisciplinary working principle by the definition. But in an urban excavation like Marmaray, construction teams were also involved in the process which created a new perspective not in methodology of archaeology but the interdisciplinary structure of it. Archaeologists, anthropologists, architects, restorators, conservators, photographers and more professionals related to different disciplines worked on and off the site. Museum staff were responsible for administrative part. Beside professionals, so many workers labour was committed to the project.

3. Rescue Excavations of Sirkeci Station

Sirkeci is a neighbourhood in the heart of the Historical Peninsula, close to Topkapı Palace, Blue Mosque and Hagia Sofia. It has been an important intersection site for the transportation of the city with the Sirkeci Railway Station, which was built in the late 19th century, and the ferry quays which has been also harbour area for centuries.
Rescue excavations of Sirkeci Station, which is the deepest station, in Marmaray, is the case study area for this paper. Sirkeci has two entrances (north-south) and two shafts (east-west) with different shapes and sizes for the construction project (Fig.3).

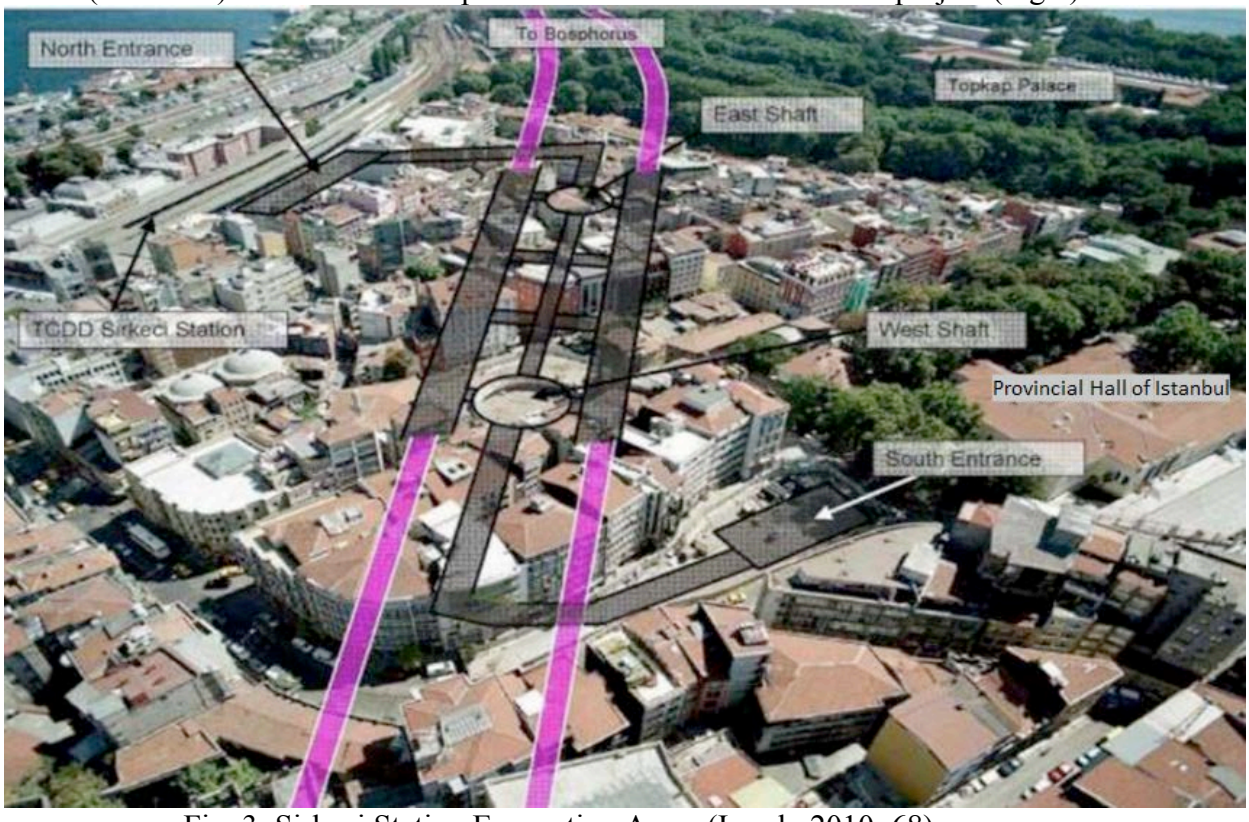

Fig. 3: Sirkeci Station Excavation Areas (Irmak, 2010: 68)

Because of the depth of the archaeological deposits, underground water, surrounding urban settlements and protection of the area, four areas have bored piles around them for safety and technical reasons (Girgin, 2007: 98) (Fig.4).

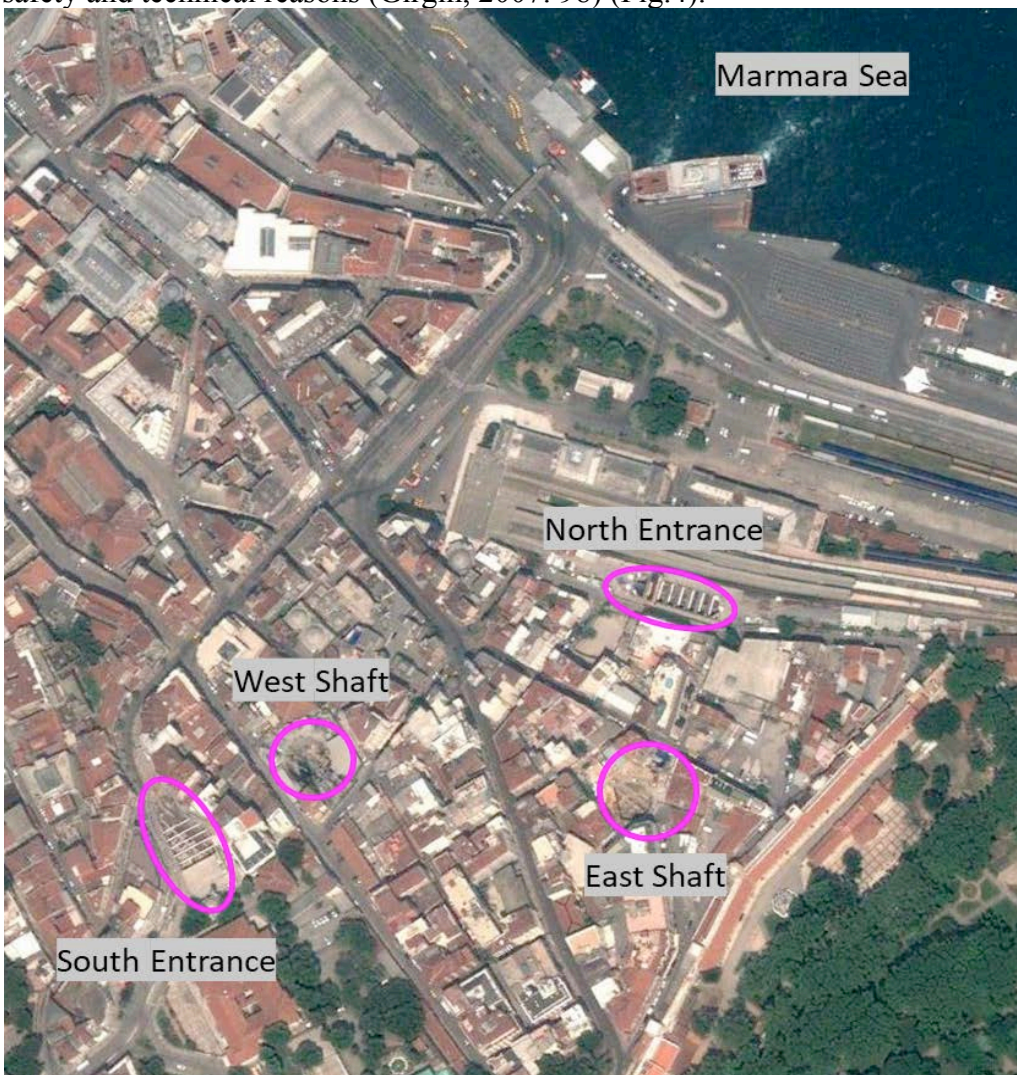

Fig. 4: Sirkeci Station Overview (Authors adapted from Google Earth)

All four areas had rescue excavations. They didn't start at the same time due to the construction process and did finish at different times. The start was in 2004 and finish was in 2012. Through all the excavations, there were more than 30 archaeologists, 5 architects[4] and other professionals worked on the project under the supervision of IAM.

Four excavation areas have a dense architectural inventory, starting from Early Turkish Republican Period to Ottoman, Byzantine, Roman and Hellenistic Periods. Because of the obligatory boundary of the sites, the context of the architectural elements was sometimes not clear or couldn't be followed on the same level but regardless this challenges it gave very important information about the historical stratification (Başaran& Kızıltan, 2016: 51). Beside architectural remnants, all sites

[4] This paper's main author worked in Marmaray Sirkeci Excavations for almost six years and spent time at Yenikapı and Ayrılıkçeşme Station Excavations on the site. Also worked on the archive study of whole Marmaray Excavations.

have also an immense data of archaeological artefacts which are studied by different scholars.

3.1. North Entrance

It is situated on the south part of the Sirkeci Railway Station. This site is important for being a new example of civil architecture complex of Byzantine Period (Tan, 2009:24). It is also understood that this site was in the ancient port of Prosphorion with some part of the east shaft (Asal, Eskalen, 2013: 251). The archaeological deposit finished in -26 m. deep which gives a new perspective to the relationship with the sea level change (Kızıltan, 2014: 70).

Fig. 5: North entrance

3.2. South Entrance

This site is so close to Governorship House dated t 19th c. on a sloppy street in Cağaloğlu District in Sirkeci (Fig. 6). It has an architectural inventory sometimes mixed into each other on the Turkish, Ottoman and Byzantine Period levels which demonstrates an uninterrupted urban life for long ages (Kızıltan, 2014: 71).

Fig. 6: South entrance (Authors adapted from nyakin.com)

3.3. East Shaft

East Shaft has two rings, one small and one large, for ventilation which is now used as another entrance for Marmaray Station (Fig. 7).

Fig. 7: East shaft (two rings together) (Irmak, 2010: 75)

The small shaft has the earliest archaeological pieces dated to BC 7th c. in Sirkeci Excavations (Girgin, 2007: 101). Large shaft a significant building complex dated to AD 5-7th c. which was removed to establish in another site by the Regional Conservation Board decision (Tan, 2009: 24). Both rings have similar architectural deposits since they are so close to each other, yet they are unique in their own way.

3.4. West Shaft

West Shaft is also a ventilation shaft which was excavated as the deepest area of Marmaray for construction. Even the north part of the shaft was ruined in early 20th c. until the Byzantine Period level, the whole shaft has very important architectural remnants (Girgin, 2007: 104).

Fig.8: West shaft (Belkaya, Ozmen, Karamut, 2008: 2)

3.5. Architectural Documentation of Sirkeci Excavations

Architectural documentation process of the excavations starts on the site. When archaeologist finishes working on a certain level (sometimes because of constructional reasons, sometimes archaeological reasons such as following the periodical change), architect collects coordinated data of architectural remnants on a proper sketch with a survey team who uses total station equipment for digital measurement (Fig. 9 a, b). The architect also takes photographs from every point of view (Fig 9 c). Then office work starts. Architect combine sketch, raw data from survey and photographs to draw 2D architectural plans, sections and elevations on a CAD-based program (Fig. 9 d). When all drawings are finished including material, mass-void, periodical analysis etc., the drawing files are submitted to the Regional Conservation Board with a detailed report prepared by IAM. This process continues until the bedrock unless any request comes from the board. If any decision, such as protecting the remains in-situ, new drawings are made and handed to IAM for applications.

Fig.9 a, b, c, d: Architectural documentation (Author's personal archive)

After all excavations on the site were finished, an archive of Sirkeci Excavations prepared by the architectural team. All files were arranged by submission date and year for four areas. After completion of the archive, everything was sent to IAM in paper and digital form.This process is a classical approach for documentation in an urban rescue excavation. With this paper, a GIS integrated solution is studied for Sirkeci Rescue Excavations as an important example for future.

4. The Process of the GIS Database

The development of multi-layered cities in the historical process increases the responsibility of archaeological museums both in the maintenance of archaeological cultural inventory and their part in the development of planning systematics in urban scale. In this paper, one of the most important aims is to represent a method with GIS for documentation method of the archaeological inventory in the example of urban archaeology. This method has many opportunities to understand the urban pattern of the past periods of the city and the planning process for the future of the city.
This GIS project can be separated into two parts. The first part was progressed for a master thesis[5]. And the second part which includes Sirkeci Rescue Excavations was progressed for a PhD thesis[6].

[5] The first part of the database was prepared by paper's co-author for her master thesis. This database includes archaeological inventories, historical maps, natural environment knowledge, present physical information, plan decision for the future and seven architectural remnants which are situated in Tahtakale Region-Istanbul.

4.1. First Database Structure

The first part of the GIS Database was prepared in order to associate the planning process with archaeological inventories. Within the scope of the 2010 European Capital of Culture Projects, studies covering the 40-year period between 1970 and 2010 of archaeological soundings and determinations carried out under the control of the archaeological museum were compiled[7]. The photographs and drawings in the annexes of the reports in the archives were scanned and stored on the computer.

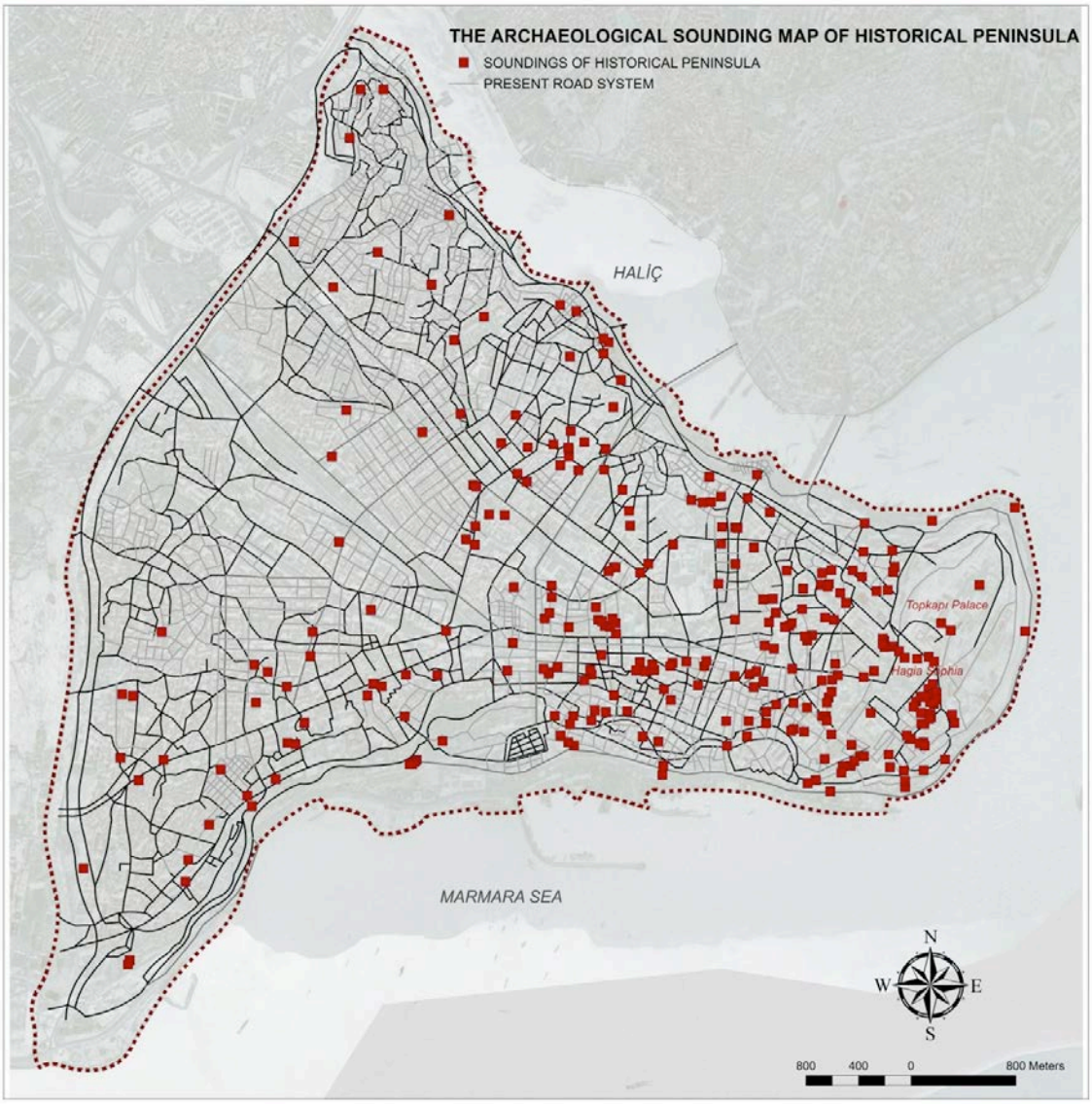

Fig.10 Archaeological Determination at Historical Peninsula

The method followed by transforming museum data into spatial datasets can be summarized as follows;

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[6] The second part of the database is a part of paper's main author PhD Project created with paper's co-author, by the permission of IAM. Sirkeci rescue excavation document was transferred to the first GIS database. With this project, more than 150 CAD folder has transferred to the database and its volume has expanded.

[7] Archaeological soundings and determinations were published as an excel list which includes some information about them by Turgut Saner and Zeynep Kızıltan.

The GIS' satellite image of the historical peninsula has been used and 414 museum files related to their location in urban space have been coordinated on smart maps. The drilling information plugs are created for each archaeological determination. The data are given in the appendix of the resource used for the creation of the database, Museum File Number, Location, Coordinates, Period, Residue Type and Finds[8]. Data are processed to these chips, so the archaeological remains which were uncovered as a result of 40 years of studies, detailed numerical data about the characteristics of the finds were obtained.

Fig.11 a,b: Historical Maps and Geological Condition

In order to determine the archaeologically protected areas, it is necessary to determine the cultural fill areas. In this context, urban archaeology and periodical topography studies are required (Emre B, 2017:166-185). Therefore, historical maps, natural environment analyses and topographic data have been added to the database.

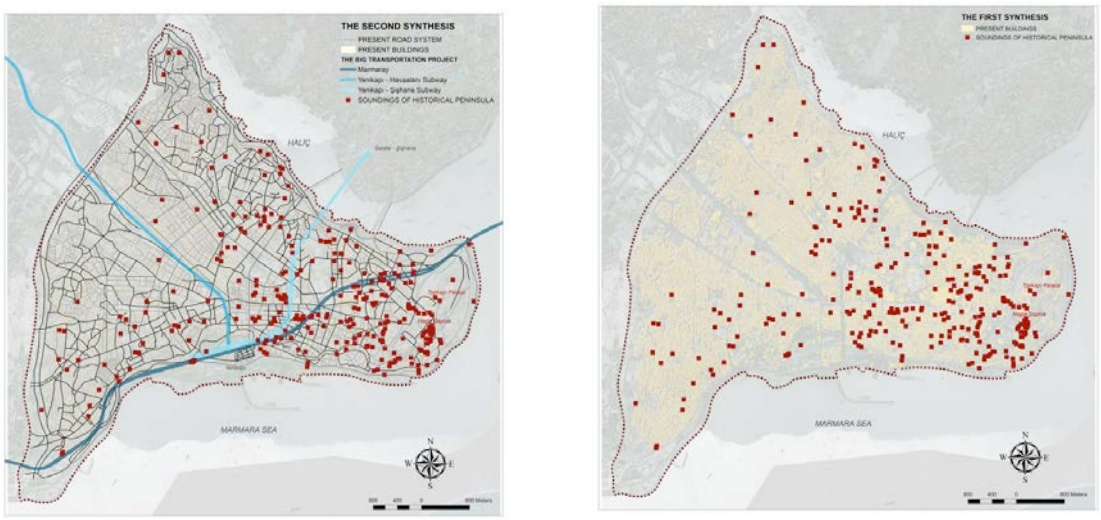

Fig.12 a,b: Physical Environment (Buildings Information and Transportation Network)

[8] All this information is stored in the system with the help of attribute table.

In order to prioritize archaeological-protected areas, it must be determined the areas where the existing conditions of construction are mostly damaged (Emre B, 2017:186-214). Fig.12 shows that present physical condition and we can observe transportation network condition as well as building positions on the archaeological inventory.

In this database, it was emphasized that each archaeological determination should be transferred to this system with museum files, because the museum files include archaeological inventory with their measurements and proportions, as well as the data of the elevation. Thus, the decision-making process in urban space will proceed in a healthy way with the awareness of the archaeological deposit areas.

4.2. Sirkeci Database Structure

The second part of the GIS database has been carried out for the study of Sirkeci Excavations and its environment, which is a very important harbour area in ancient Istanbul, in the context of urban archaeology. This part includes the process of transferring the architectural elements of the Sirkeci rescue excavations with the elevation, period and material knowledge.

The work carried out on four excavation areas which were recorded with more than 150 cad files which could be seen in the example of east shaft archive (Fig. 13).

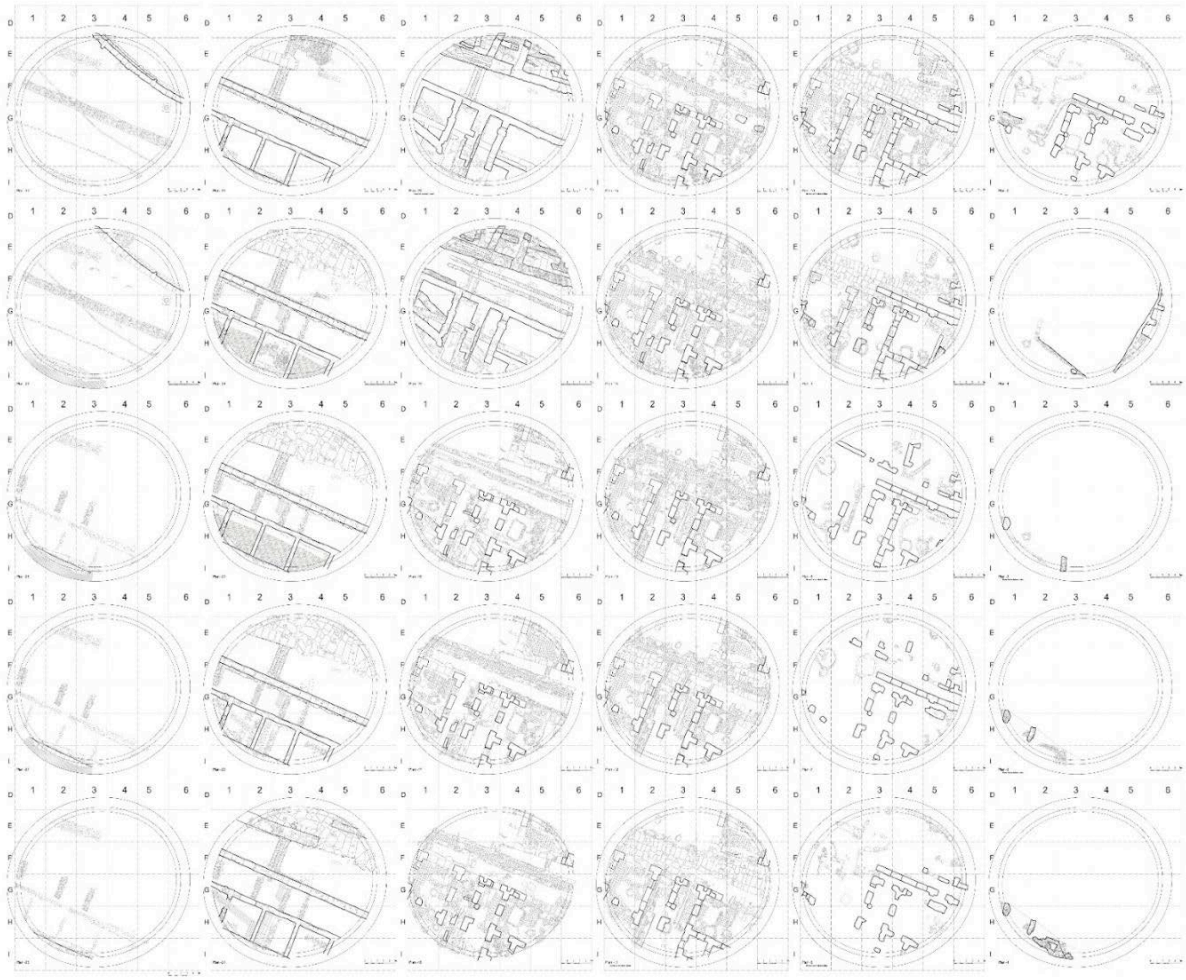

Fig.13 East Shaft Large Ring Drawing Archive

First, these files are converted into spatial data. Afterwards, the transfer operation was started from the upper level, only the new parts from each CAD file were added to the system with elevation, material and period data and the process was repeated until the bedrock. This information is kept in the attribute table. The Arc-GIS program working with GIS can be used to make queries based on different characteristics. Fig. 14 was prepared with material information for four excavation areas, based on data of peer period.

Fig.14 The site plan of the Sirkeci Excavations

Thanks to the database developed in two stages, it is possible to make serious inferences both on the urban scale and spatial scale for both archaeological research and planning process. This system is open to store the knowledge of the archaeological inventory from the smallest to the largest architectural monumental structures. It is the most important feature of the system to ensure that the different data sets are combined and open to different definitions (Emre B. & Ozturk A., 2018, 53-88). Therefore, all the finds could be evaluated in a holistic way within the urban context.

4.3. Advantages and Disadvantages

In Turkey and in the world, the planning decisions taken in the urban space hosts together advantages and disadvantages for urban archaeology. Determining the archaeological inventory is vital for planning in terms of spatial continuity as well as archaeology and urban studies.

Ensuring spatial continuity in historical multi-layered cities requires a combination of many components. Today, one of the main problems encountered in the historical environment is to lose its references to the past. In the UNESCO World Heritage Committee meeting in New Zealand in 2007, urban infrastructure projects, contemporary architecture and high buildings and the devastating effect of urban change and development were highlighted by the countries participating in the meeting (Dinçer, 2013: 23). Cultural heritage in countries where there are extensive contemporary investments, such as Turkey, is under serious threat with difficulty to keep the balance between the economic improvements and preservation of the inventory (Kızıltan and Uyar, 2011: 8). The basis for these problems is the lack of a proper database of different periods of history in the urban area. All this can be achieved depending on the quality and quantity of a strong pool of data and the combination of different disciplines.

The city history was rewritten with transportation projects in Istanbul. Now the importance of this city is more clearly known. Therefore, it is a great necessity to carry out serious research on the city's potential archaeological sites which are under the threat of existing building conditions.

All over the Historical Peninsula entire urban archaeological inventory with elevation values should be digitized in the GIS database. This inventory must be considered when urban planning especially for the transportation systems. In this way, it will prevent the destruction of the cultural heritage areas and make the decisions by seeing this inventory and adding them to the design (Emre B, 2017: 207). In the multi-layered urban system, it is imperative to benefit from past knowledge and to preserve cultural values. Sustainable development, increasing the quality of urban life and simultaneously protecting concrete and intangible cultural assets is very difficult (Dinçer, 2013: 22-23). All these requirements can only be achieved through correct planning approaches and using different planning tools like archaeological inventories' database.

Conclusion

To create GIS database for Historical Peninsula and Sirkeci Rescue Excavations plays an important role in the perspective of archaeological research, conservation strategies of archaeological inventory and planning process.

One of the most important opportunity of the study is explaining the relationship between archaeological inventory and transportation project. There are many options that processed with the GIS in order to detect, record, analyse, synthesize, evaluate, conserve and manage the data of archaeological inventories.

Archaeology uses and needs complicated knowledge from different disciplines. The placement of archaeological studies in GIS provides great convenience for interdisciplinary work by using overlap features. Another important benefit of transferring archaeological studies to GIS is that the system, which can store data at different scales, utilizes to make a holistic assessment and multiple interrogations.

Archaeological studies are carried out with many difficulties in the urban area, especially such a lively and multi-layered city like Istanbul. The studies provide information about the different periods of ancient Istanbul from the archaeological determination and rescue excavations. Marmaray Sirkeci Excavations as a case study are very important to present the potential of using a new approach for more efficient documentation process, especially for architectural part. This kind of database in archaeology would give opportunities to interpret complex relationship between cultural stratifications and with ancient topography as well. It would also create awareness for the cultural heritage protection by emphasizing its presence. It is also significant for further research for all kind of disciplines studying on the archaeology which could make only database more useful and profound with new additions (Fig.15).

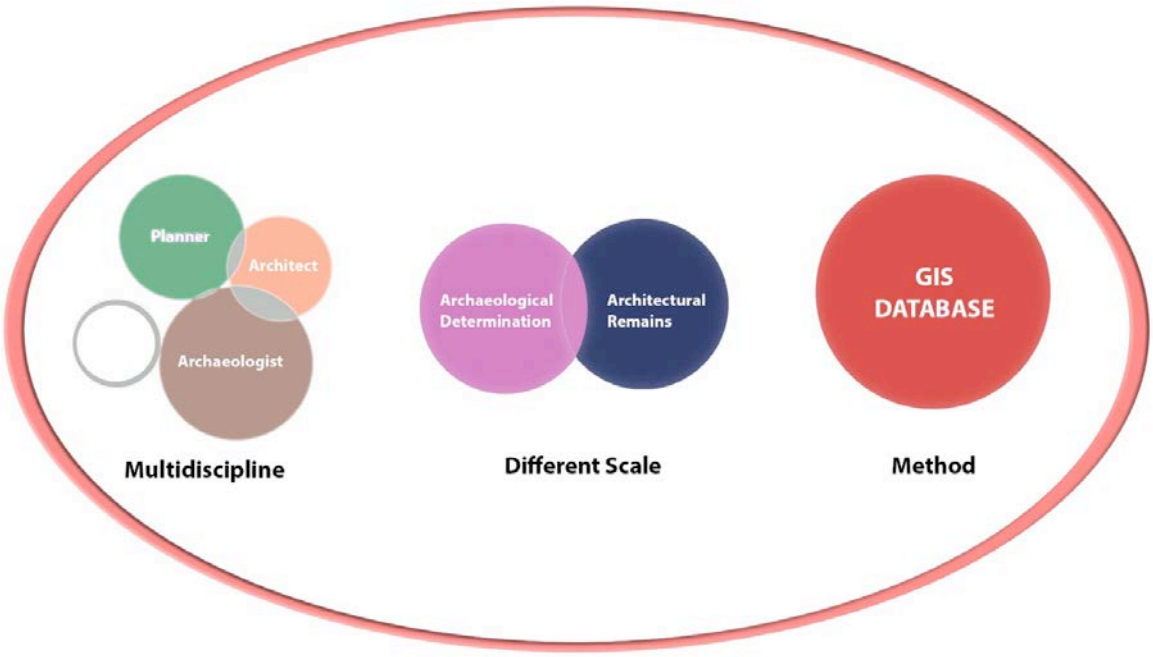

Fig.14 Schematic holistic approach

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